Monetizing Disinformation in the Attention Economy: the case of genetically modified organisms (GMOs)

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Abstract:
The ubiquity of social media has created both opportunities and challenges for businesses and societies. For product brands, ideas, or campaigns to gain traction on social media platforms, they need to capture attention. This is often accomplished by creating and disseminating compelling information, even disinformation, on these platforms. Strategies that drive this attention economy are often not obvious. The monetization of disinformation is explored here through a case study on genetically modified organisms (GMOs) and the analysis of a dataset of 94,993 unique online articles. When combined these methods allow for the evaluation and exploration of various tactics that contribute to the evolving GMO narrative and their potential application to other topics. Preliminary results suggest that a small group of alternative health and pro-conspiracy sites received more totals engagements on social media than sites commonly regarded as media outlets on the topic of GMOs. Other externalities observed include continued social and political controversy that surround the GMO topic as well as the growth of additional product and marketing approaches such as "non-GMO" verification.

Keywords: social media, disinformation, attention economy, GMOs, genetic engineering

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The ubiquity of social media has created both opportunities and challenges for businesses and societies. For product brands, ideas, or campaigns to gain traction on social media platforms, they need to capture attention. This is often accomplished by creating and disseminating compelling information, even disinformation, on these platforms. Strategies that drive this attention economy are often not obvious. The monetization of disinformation is explored here through a case study on genetically modified organisms (GMOs) and the analysis of a dataset of 94,993 unique online articles. When combined these methods allow for the evaluation and exploration of various tactics that contribute to the evolving GMO narrative and their potential application to other topics. Preliminary results suggest that a small group of alternative health and proconspiracy sites received more total engagements on social media than sites commonly regarded as media outlets on the topic of GMOs. Other externalities observed include continued social and political controversy that surrounds the GMO topic as well as the growth of additional product and marketing approaches such as "non-GMO" verification.
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1.0 Introduction

In our interconnected world, businesses have the capacity to influence and engage in dialogue about technology and facilitate the delivery of value-added products. While it is difficult to imagine conducting business today without a social media strategy, there are significant challenges that come with these new commercial and communication channels (Confente, Siciliano, Gaudenzi, & Eickhoff, 2019; Sabate, Berbegal-Mirabent, Cañabate, & Lebherz, 2014). This "Brave New World" (Berger, 2017) brings new players into scope who craft, share, and monetize information and narratives in novel ways. When these narratives, constructed of strategically interrelated ideas (Pickard, 2013), are inaccurate, they can conflict with business objectives. Simply put, there is a new kind of competitor that seeks to monetize attention to disrupt, disparage, and support alternative campaigns through misleading information. This also has implications for broader societies. For example, misleading information can influence public perceptions and policy regarding key health issues such as autism (Keenan & Dillenburger, 2018) or vaccines (Rosselli, Martini, & Bragazzi, 2016).

For the purposes of this paper, we adopt and use the term disinformation following on Fallis' (2009, 2011, 2014, 2015a, 2015b) and S. Kumar, West, and Leskovec (2016) interpretation of the term. Disinformation, in this context, is viewed as "a product of a carefully planned and technically sophisticated deceit process" (Fallis 2009) by grabbing attention and monetizing it to meet rent-seeking ends. Rent seekers pursue interests in the competition for this attention and use disinformation to attract that attention. Disinformation affects public opinion, which not only affects businesses but also has other socio-economic and public policy consequences (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Paarlberg, 2014). A study by Kata (2010) found misinformation to be widespread wherein legitimate studies were often misrepresented on 88% of surveyed websites. For example, the misinformation that vaccinations will lead to autism has contributed to the rise of vaccine-preventable diseases, such as the measles (Jang, Mckeever, Mckeever, & Kim, 2019; Perkins, 2019).

The disinformation landscape is firmly planted in what is known as the attention economy (Simon, 1971). In the era of media digitalization, there is a new focus on an attention economy that is tied to the rise of the Internet and social media, which have low barriers to entry. Anyone can become a vendor and profit from attention.

The proliferation of information and the ubiquity of social media have created both opportunities and challenges for companies (Paniagua, Korzynski, & Mas-Tur, 2017; Wagner, Baccarella, & Voigt, 2017). The biggest challenge is reputational (Confente et al., 2019; McCorkindale & DiStaso, 2013). The strategies driving the mobilization of disinformation are often not visible. Nor is the attention economy that underlies those transactions. Mapping or understanding the disinformation landscape, its drivers, and the vendors that derive profits and economic rents from it, is important in finding ways to manage the societal and business impacts it may cause.

This paper:

1) defines and distinguishes disinformation from misinformation;
2) outlines how the internet and social media have revolutionized human to human interactions and contributed to the proliferation of disinformation;
3) reviews how disinformation is monetized in the attention economy, and
4) collectively examines this through the lens of a narrowly focused case study involving the genetically modified organisms (GMO) narrative.

Literature Review

2.1 Disinformation and misinformation

When sociologist Manuel Castells (1996) conceived of the network society, he acknowledged how new media and communication technologies contributed to a fundamental change in culture where societies were organized around information and networks. It is unlikely that Castells could have anticipated just how influential and ubiquitous information and virtual networks would be today. The internet and social media have radically transformed and fueled how individuals, communities, and organizations create, share, and consume information (Baccarella, Wagner, Kietzmann, & McCarthy, 2018). Moreover, while social media platforms have the capacity to expand our world in new and exciting ways, they are also vehicles for destructive information behaviors (Karlova & Fisher, 2013). The creation and cultivation of deceptive information can undermine certain aspects of society, shifting economic and political power in ways that can have negative effects (Broniatowski et al., 2018). As Baccarella et al. (2018) suggest, social media has a "dark side."

Understanding this "dark side" of our interconnected world is a challenge faced by businesses, policy- and decision-makers, and societies. Colic-Peisker and Flitney (2018) state that while democracy may be enhanced through this increased interconnectivity, it is also endangered by the ubiquity of social media. The authors suggest that this leads to opinion echo chambers, the spread of fake news, and the corruption of the public discourse (Colic-Peisker & Flitney, 2018). The new information society is complex (Beck, 2014; Castells, 1996, 2010; Giddens, 1999) and scholars continue to struggle to wrap

their heads around its abstractness (Galukhin, Ivleva, & Novikova, 2018; Ricci, 2000). Castells (2010) voiced reservations in how social scientists have responded to these complexities. He suggests that misperceptions are socially produced or constructed (Arsenault and Castells, 2006), which may be difficult to track and quantify. This presents problems for businesses and organizations as they try to manage misinformation about products or ideas or reputational issues that arise in this interconnected age of information.

If social media is a vehicle for false or deceptive information, then what is being transported can be characterized in many ways: fake news or pseudo news (Kent, Harrison, & Taylor, 2006), post-truth pronouncements (Grech, 2017), misinformation, or disinformation. While these terms can be considered material or abstract forms of communication that societies can be informed by, it is not always clear what the terms mean and how they differ from one another. These terms are often used interchangeably. To better understand the nature of deceptive information, we adopt a constructionist interpretation of information. This approach is useful when discussing misinformation or disinformation as it emphasizes the role of social context and conversations among people as ways of shaping interpretations of information and what is deemed informative (Karlova & Lee, 2011).

Information is often assumed to be agnostic, neutral, or fact-based. Fake news or pseudo news are forms of information that are often presented in the media as factually correct (Baccarella et al., 2018). Yet, this kind of information lacks key accuracy factors that are considered critical dimensions of information. The popular appeal and often sensational nature of these brands of information are attractive to broad audiences (Baccarella et al., 2018).

Inaccurate information is categorized as either misinformation, disinformation, or both in the literature. Misinformation is referred to as inaccurate information (Fallis, 2009, 2014; Karlova & Fisher, 2013; Karlova & Lee, 2011) or incomplete (Karlova & Lee, 2011; Losee, 1997; Zhou & Zhang, 2007). Misinformation "…can mislead people whether it results from an honest mistake, negligence, unconscious bias, or (as in the case of disinformation) intentional deception" (Fallis, 2014). Disinformation is distinguished from misinformation in that it is information meant to intentionally deceive (Karlova & Fisher, 2013). Fallis (2009, 2011, 2014, 2015a, 2015b) provides an overview of disinformation stating that "…disinformation is often the product of a carefully planned and technically sophisticated deceit" (Fallis, 2009). He refines his interpretation of disinformation even further in 2014 (suggesting that the 2009 characterization was too broad) stating, quite simply, "disinformation is misleading information that is intended to be misleading" (Fallis, 2014).

Purposeful distribution of disinformation can lead to the spread of misinformation, which only serves to further the tactics of the source. In the context of complex issues such as GMOs or vaccines, compelling and believable disinformation leads to its amplification via mainstream media and through social media. In these kinds of situations, media and the press serve as a vehicle for not only promoting accurate and inaccurate scientific findings but also in fueling debate or creating controversy regarding important scientific matters (Hochadel, 2016). Moreover, while further amplification of disinformation in this way may not be purposely deceptive, it is still considered as the perpetuation of disinformation or an unintentional act of misinforming (Fallis, 2014). Disinformation vendors rely on the public's normative

conception of information where all "information is viewed as consistently accurate, true, complete, and current" without considering the validity of or impacts for claims (Karlova & Fisher, 2013).

2.2 Disinformation in an interconnected world

Disinformation, no matter how it is defined, is nothing new. You only need to think of H.G. Wells' *War of the Worlds* aired by a Buffalo, NY radio station in 1968 (Grech, 2017) or consider the various formats of "reality" or performance-based programming that has evolved throughout television history (game and crime shows, soap operas to modern scripted programs) (Creeber, 2015). Humans are not strangers to being presented with bits of information that do not necessarily reflect the truth. What *is* new, however, is, first, the scale at which the disinformation problem has grown and, second, the "echo chamber" effect of positive feedback loops that fuels the spread of disinformation. Both, according to Berthon & Pitt (2018, p. 3)"…are technologically enabled by the Internet, and biologically driven by human, inbuilt cognitive biases."

The scale and scope of disinformation is best illustrated by how social media has revolutionized human to human interactions. Anthropologist and evolutionary psychologist, Robin Dunbar, explored the social aspects of human-to-human relationships and networks. Dunbar's Number, as it has been coined, represents the total number of relationships or people that an individual can manage within their personal network (Dunbar, 1992). The quantitative constraint (n=150) has to do with human cognitive limitations and the capacity for a single individual to be connected to others in meaningful ways. Dunbar's "cognitive limit" no longer holds in our modern interconnected world, where the nature of our personal networks has changed both quantitatively and qualitatively. Estimates now suggest that an individual can have a mean number of well over 600 connections (Wellman, 2012). Add to this, the multiplier effects that come with interconnectivity and the user interface of social media.

Social media is an "active and fast-moving domain" (Kaplan & Haenlein, 2010, p. 64) and has revolutionized how we connect and socialize as human beings. The scale of the platforms has raised the speed limit in our information society, and cognitive psychology research has explored and identified patterns in the use of social networks to spread disinformation (K. K. Kumar & Geethakumari, 2014). Blogs, Twitter™, YouTube™, and Facebook™ have all become vehicles for citizen journalists to share information that goes largely unmonitored and unchallenged (Gant, 2007). K. K. Kumar and Geethakumari (2014, p. 5) characterize social media as a "Pandora's Box" suggesting that "…preventing the spread of misinformation is a more effective method of combating misinformation, than its subsequent retraction after it has affected the population." Users or readers tend to believe what they see on their computer screen, viewing it as "a certificate of truthfulness of information being presented to them" (K. K. Kumar & Geethakumari, 2014, p. 1). Humans are story seekers (Kurtz & Ketcham, 2015), so intuitively follow a (compelling) storyline and not necessarily the journals, publications, or writers that write and publish them. Therefore, information errors that are caught and corrected will not even be on the radar for most readers. Adding to all of this are the base human cognitive habits of confirmation bias, bandwagon effect, or herd mentality where citizens tend to conform their beliefs about science, society, and risks "to beliefs that predominate among their peers…" (Kahan et al., 2012, p. 732).

Many have learned to game the social media system, monetizing the fundamental disconnect between accurate information and the internet users' behavioral habits and biases. Additionally, When false information circulates in the form of rumors, urban legends, and conspiracy theories and appears in a social network like Facebook, users are often compelled to share and disseminate it ((Chen, Conroy, & Rubin, 2015) and (Del Vicario et al., 2016) as cited in (K. K. Kumar & Geethakumari, 2014)). Sharing is an important part of the disinformation business model.

2.3 Monetizing disinformation in the attention economy

The disinformation landscape is firmly planted in what is referred to as the attention economy. Herbert A. Simon originally conceptualized the notion of attention economics (1971):

> "What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it" (pp. 40–41).

Attention economics applies economic theory to solve information management problems and treats human attention as a scarce commodity. Attention is a limited resource and, therefore, the attention economy is a competitive market. While it has been explored in business settings for leveraging attention for positive gain, the potential negative impacts of the attention economy have not been explored thoroughly (Crawford, 2015; Davenport & Beck, 2001). Attention, itself, is focused cognitive engagement on a piece of information. Something comes into our awareness, we notice it, and then we decide whether to act based upon our observations (Davenport & Beck, 2001). As Matthew Crawford states: "Attention is a resource—a person has only so much of it" (Crawford, 2015, p. 11). Social media is a lucrative space for mining personal data for marketing and advertising (Duffett, 2015; Lin & Kim, 2016; Mahfouz, Joonas, Williams, Jia, & Arevalo, 2017). By default, it is an engine for generating income.

From a business standpoint, there are low barriers to entry in participating in the attention economy. Anyone can become an attention vendor. Attention vendors enter the market and distract or draw patrons or customers into monetized business models. This is often accomplished by monetizing attention through advertising. Vendors "use complex statistical models to predict and maximize engagement with content" (Lazer et al., 2018). An article in BBC News (Miller, 2018) documents the relatively invisible, yet widespread industry of monetized clickbait, spreading fake news is a profitable venture (Broniatowski et al., 2018; Miller, 2018).

If you can create doubt, you can generate income in an attention economy by grabbing a user's attention and then by selling that attention to others. Disinformation can be viewed as the new currency for those businesses (Davenport & Beck, 2001). Disinformation is easily replicable. Sharing it is practically cost-free, accessible, and customizable (Kelly, 2008). The popular appeal and often sensational nature of disinformation "attracts millions of readers" (Baccarella et al., 2018, p. 435). And because it attracts the masses, it can be weaponized to undermine or target products, people, and ideas and – ultimately – used for monetary gain. How this is done, in practice, is less understood. The distribution and exchange channels for disinformation on the internet are often not readily visible.

Algorithmic approaches, behind targeted disinformation, are increasingly automated. While businesses and marketers leverage these digital realities to promote value-added products, many brands are becoming increasingly entangled in dark-side, disinformation campaigns:

> "They are the direct targets of fake news and directly fund fake news, and indirectly they endorse fake news, and in turn, are tarnished by association. Together, these two areas undermine both the credibility and trustworthiness of brands" (Berthon & Pitt, 2018, p. 16).

Another contributing factor to the reality of the attention economy is the ease with which disinformation campaigns can be organized and promulgated in a networked society. Cyber-activism (facilitated through the internet) has essentially "changed the street protest and the online protest" (Sandoval-Almazan & Ramon Gil-Garcia, 2014). "[O]nce a group can create a mass reaction, they start building an online community" (Sandoval-Almazan & Ramon Gil-Garcia, 2014).

Activist campaigns and those that organize them benefit from the ease of clicktivism (Halupka, 2014) where the Internet provides new ways to act and activate around issues. The networked society has made it easy for activists and followers alike to share ideas and positions and to attract donations. Social media has "…become a perfect complement for social protests" (Sandoval-Almazan & Ramon Gil-Garcia, 2014). As Stevens, Aarts, Termeer, and Dewulf (2018) outlines, attention is directed toward a given cause (name and blame) rather than the consequence of the event in question: "…[P]eak activity on social media revolves around a few themes, is recurrent and judgmental…" (Stevens et al 2018, p.11).

Monetization of attention is explored by Thompson (2016) where he examines public relations activism and rent-seeking and the political economy of persuasion. Attention vendors misrepresent intentions by positioning advocacy campaigns as acting in the public interest rather than disclosing that actions and activities are motivated by rent-seeking goals. Moloney (2006, p. 33) qualifies these actors as "closer to protest businesses than protest groups." Tullock and Rowley (2005) explore the combined effect of mass media, interest group campaigning, and the politics of persuasion, which have served as a diversion for businesses. Negative narratives and activist campaigns also affect other things: in the context of GMOs, they distract from addressing real issues around food security, food safety, food waste, which leads to social costs. Unfortunately, businesses have missed the mark by leaning heavily on traditional marketing and communication tactics while, at the same time, using social media solely to promote benefits of their products (Boyd, McGarry, & Clarke, 2016). Attention vendors with ulterior motives recognize this gap and tap into human informational behaviors and cognitive habits, monetize the disinformation, and subsequently profit from it.

3.0 The GMO Narrative in the Attention Economy: a case study

3.1 Background

A GMO – or genetically modified organism – is defined as an organism whose genetic material has been altered using genetic engineering techniques. Although terms like "Biotech", "GMO" and "genetically engineered" are used by advocates of the technology, critics almost exclusively use "GMO" because of the public's lack of familiarity of the technology (genetic engineering) (Stofer & Schiebel, 2017). This helps to connect cognitive perceptions of something scary with the unfamiliar.

As of 2016, GM-traited crops were reported to be grown on about 186 million hectares of land worldwide (ISAAA, 2017). Brookes and Barfoot (2018) state that the adoption of GM crops represents significant net economic benefits at the farm level "…amounting to $18.2 billion in 2016 and $186.1 billion for the period 1996–2016 (in nominal terms)." More than half of those benefits, the authors' state, accrue to farmers in developing countries (~52%).

GM crops undergo stringent regulatory approvals and safety testing all over the world (McHughen & Smyth, 2008; Smyth & McHughen, 2012). It takes almost $140 million (USD) and up to 13 years to bring a genetically engineered trait to market (McDougall & Phillips, 2011; Smart, Blum, & Wesseler, 2017). To date, more than 3,000 scientific studies have assessed the safety of these crops in terms of human health and environmental impact (Norero, 2017). In total, 284 technical and scientific institutions around the world including the American Association for the Advancement of Science (AAAS), the European Commission, the Royal Society of Science, and the World Health Organization recognize the safety of GM crops and their potential benefits (Norero, 2017). Additionally, an independent consensus paper, carried out by the National Academy of Sciences, examined a range of questions and opinions about the economic, agronomic, health, safety, or other effects of genetically modified crops, and found them to be as safe as their conventionally grown equivalents (National Academies of Sciences & Medicine, 2016). Despite this evidence, there continues to be social and political controversy about the safety of food derived from genetically engineered crops. GMO is employed as a "dubious meme often used as a target for determined opposition by many activist groups"(Tagliabue, 2018). It is a meme used in efforts to "purposely sow dissenting positions concerning [GM] crops in the United States" (Dorius and Lawrence-Dill, 2018).

According to Stevens et al. (2018), a primary strategy in activism is to problematize agriculture and propel those "problems" into online spaces where media, citizens, and communities share and reshare it. The best vendors can effectively game the attention economy to their (monetary) advantage. This activity is a means to an end and a channel for profitability for actors. Agriculture and food production have gained wide public and media attention, and that attention is not always positive. Public opinion, for example, diverges greatly from scientific consensus regarding the safety of genetically modified (GM) foods (Funk, Rainie, & Page, 2015; McFadden, 2016). The topic is a deeply politicized one invoking controversy and strong emotional responses (Aerni, 2018) with concerns regarding food safety, lack of transparency in the food system, and an enduring distrust of "Big Ag" and the industry more broadly (Tagliabue, 2018). This has led to the rise of secondary or opportunistic markets that may not reflect scientific evidence and are fueled through the cultivation of uncertainty and fear for emerging technologies (e.g., genetic engineering, gene editing, synthetic biology, and nanotechnology). According to the published results of a survey administered to agriculture communication experts, people believe that "technology is dangerous to their health and planet, and unrealistic demands are placed on farmers from government agencies that aren't based in science, [n]or [are they] practical" (Kurtzo, Hansen, Rucker, & Edgar, 2016).

As Clancy and Clancy (2016) state, the anti-GMO movement is one of the most successful in modern history. American economist and social theorist, Jeremy Rifkin, credits himself for starting the movement over 30 years ago: "You know where the opposition to GMOs started? In my office. We

started the whole opposition worldwide" (cited in (Anslow, 2016)). A cursory review of the timeline starts with Rifkin's activities in the late 1970s and 1980s (Lynas, 2018) to the commercialization of the first genetically engineered crops in the mid-1990s. The latter was the impetus behind the organization of NGOs and the rise of the counter GMO narrative in Europe in the 1990s (C. D. Ryan, 2014). Other events merely served to exacerbate the controversy. For example, the bovine spongiform encephalopathy crisis of the late 1990s irreparably damaged an already tenuous trust relationship between the public and government in how food safety was managed (Aerni, 2018; Jacob & Hellström, 2000).

Much has changed over the past 20 years. Mobilization of information through the self-reinforcing context of social media has radically changed information-sharing behaviors from previous generations. In our networked society, sound and information bytes are limitless, yet attention is a scarce resource. The environment has led to the rise of an attention economy where stakeholders compete for those limited resources. Those that are most successful are those with the best narratives, with the best product-market fit in the attention economy, and the resources to capture that value.

The narrative around GMOs has been shaped by many detractors over the years that use internet and social media to shape broader public opinion about GMOs; grabbing attention across several platforms. The rents from sharing disinformation are significant when it comes to food and farming, which has gained wide public and media attention over the past several years. Anti-GMO protests, in particular, "were among the most successful protest movements in modern history" (Clancy & Clancy, 2016). The current paper represents an initial effort to examine the debate on GMOs more closely through information (factual and misleading) in various social media and mainstream outlets over the last 10 years. An effort is made to determine the driver(s) or events triggering the GMO debate from political and scientific standpoints.

3.2 Method and data collection

The GMO case study is supported by a quantitative analysis of data encompassing 94,993 unique online articles between 2009 and 2019. An analysis of these data examines social media engagement with online content pertaining to GMOs. The impact is measured in terms of total shares and an evergreen score for each article. A preliminary analysis to determine the driver(s) or events triggering the GMO debate from political and scientific standpoints was also performed.

Social media data were collected using defined search terms for the GMO topic on the BuzzSumo™[1] content research platform, which aggregates social media engagement data for various content on the internet across popular platforms like Twitter, Reddit, Facebook, and Pinterest. The BuzzSumo™ platform returned unique English-language article URLs with additional social media metrics per article based on this search. Search results through BuzzSumo™ are limited to 100,000 of the most shared

[1] BuzzSumo™ (BuzzSumo, Brighton and Hove, UK). Data Collection Search String: 'gmo OR gmos OR "genetically modified" OR "genetically modify" OR "genetic modification" OR "genetically engineer" OR "genetically engineered" OR "genetic engineering" -bitcoin -internet -bacteria -animal -embryo -HIV' Terms preceded by a "-" were specifically excluded from the data collection to reduce irrelevant data.

articles of which 94,993 were unique. Two social media metrics from BuzzSumo™ were leveraged for analysis:

> Total Shares – total shares for any available URL on social media are a sum of the number of shares, likes, and comments the URL receives on Facebook, the number of tweets, and retweets containing the URL on Twitter, the number of shares of the URL on Pinterest, and the number of Reddit engagements, which are a sum of upvotes and comments, subtracting any downvotes on posts including the URL.
>
> Evergreen Score - Evergreen Score, a metric developed by Buzzsumo™, measures the number of backlinks or shares an article receives 30 days after it was initially published (deLima Rubb, 2018).

These two metrics enable the exploration of web domains, which have received the most total social media sharing and whose content has the greatest persistence online.

The 94,993 unique articles are from 17,100 unique domains between March 2009 and March 2019. This dataset was used to describe the GMO topic and social media engagement in online media (news, blogs, and websites).

Individual articles were grouped by domain and trimmed to include only those domains that published more than 48 total unique articles. This threshold was chosen to represent domains that published on average once per month for 4 of the years included in the dataset. The resulting dataset used for subsequent analysis included 263 unique domains. Median values were calculated for total engagements and Evergreen Scores for each unique domain and used to rank them.

Additional data points were included to evaluate the singular or collective outcomes of events or initiatives on social media engagement. The key events, measures, or political initiatives include the following:

1) California's Proposition 37 (Prop 37), the Mandatory Labeling of Genetically Engineered Food
2) Washington Initiative 522 (I-522)), the Mandatory Labeling of Genetically Engineered Food
3) Organized anti-GMO demonstrations or events
4) The founding and growth of the Non-GMO Project

3.3 Results

Two figures were generated to further explore the full dataset collected for this analysis. Figure 1 describes the volume of publishing activity per month in the full dataset. Figure 2 describes the total sharing, as measured by Buzzsumo™ total shares, of the articles in the full dataset aggregated by month. Taken together these data indicate that both the number of articles published and the total shares of the articles published have peaked and declined in the time frame of this analysis.

Table 1 and Table 2 include the top 50 results of median total shares and median Evergreen Score calculations for each unique web domain included in the trimmed dataset described above. These tables are ranked by total shares and Evergreen Score, respectively. Exploration of these results shows that sites commonly regarded media outlets like The Guardian, Mother Jones, NPR, Wallstreet Journal, and

Washington Post, among others, are in the top 50 by these measures. It also shows many of the sites included are commonly referred to as alternative health and pro-conspiracy sites whose content, in a brief review, appears to be more negative and sensational in comparison.

These results also indicate that these alternative health and pro-conspiracy sites were more active in their publication of content than media outlets. When examining Evergreen Score data in Tables 1 and 2, it is important to note that backlinking strategies for media and other websites likely differs; for example, websites with common themes may be more likely to backlink each other's content than media outlets due to promotional or competitive reasons.

Further research should be conducted before drawing concrete conclusions, but these early results illustrate the potential impact of alternative health and pro-conspiracy sites compared to media outlets from a social media perspective. To strengthen these findings, further analysis including systematic media type categorization (mainstream media, alternative health and pro-conspiracy, etc), tone, or sensationalism scoring of individual articles, and audience reach and overlap could be completed.

3.4 Triggers for and outcomes of media coverage

Most of the publishing and social media sharing of articles pertaining to GMOs occur between 2013 and 2016 (Figures 1 and 2). A preliminary review of content suggests that the four principal drivers of the GMO conversation are traditional activism, science by press conference, social media science, and legislative measures.

Traditional activism activities are viewed as social and organizational change agents (Germain, Robertson, & Minnis, 2019). They include things like grassroots demonstrations or marches (Gupta, 2015; McCauley, 2014). Traditional activism can lead to more extreme actions including acts of vandalism. For example, more than 80 acts of vandalism of research trials on GMOs were reported in the EU (Kuntz, 2012). There was also a case of deliberative destruction of research facilities where a company was developing fast-growing eucalyptus in Brazil (Prakash, 2015) in addition to protestor attacks on Golden Rice trials in the Philippines (Lynas, 2013).

Science by press conference (also characterized as "advocacy science" (Gerasimova, 2018)) is a phenomenon conceptualized by Andreopoulos (1980) but has gained a new foothold in recent years. Mass media provides new channels where scientific works gain media attention prior to the process of peer review or publication (Jerome, 1989). As is the case in these kinds of situations, media and the press serve as a vehicle for not only promoting accurate and inaccurate scientific findings, but also in fueling debate or creating controversy regarding important scientific matters (Hochadel, 2016). Some examples are: cold fusion and vaccines and autism (James, 2011), the cocaine-like addictive characteristics of Oreo cookies (Humphreys, 2013), and cancer and GMOs (Butler, 2012; C. D. Ryan, 2014)

> "Putting out a sensational press release before experts in your field have had a chance to evaluate your scientific work is bad for science and bad for society…When the shocking claims in that press release were disseminated by journalists, the public was misled and the science was cheapened" (Humphreys, 2013).

Science by social media is the use of various online platforms to share non-peer reviewed data and to assert unsubstantiated claims as scientific facts. A good example of this is the "Stunning Corn Comparison" data that were published on a website that "told a disturbing and shocking story" that non-GMO corn is somehow remarkably different from GMO corn (Folta, 2018). Science by social media is an effective tool that disinformation vendors can bypass the peer review process and share work. They tap into the public's base fears and biases and rely on normative conceptions of information where all "information is viewed as consistently accurate, true, complete, and current" without consideration for the validity of or impacts for claims (Karlova & Fisher, 2013).

Another category of factors that contribute to the increase in media output on GMOs are legislative measures (Figure 3). The Proposition 37 ballot initiative in California in November 2012 for the "Mandatory Labeling of Genetically Engineered Food Initiative" (known as "Prop 37") generated a great deal of publicity, which fed the evolving GMO narrative for some time after. It brought the public-policy debate on GMOs to a new light in the United States (Alston & Sumner, 2012; Clark, Ryan, & Kerr, 2014). Following on from this was the Washington State Initiative I-522 on the labeling GM foods (Marsh et al., 2013), which was on the November 2013 state ballot. Collectively, these events had a great deal of impact on the narratives that evolved over the subsequent months and years (Clark, Ryan et al. 2014).

The total shares data (Fig 2) were overlaid with selected key events from the same period enabling an exploration of the relationships between these events and engagement with online articles on the topic (Fig 3). The petitions, proposals, and defeats coincide with moderate changes in content engagement patterns. For example, there are several notable drops in total shares following the defeat of key initiatives (labeled 4 and 8), while global protests netted noteworthy increases in content and content engagement (7*). Additionally, engagement increased significantly following the Farmer Assurance Provision[2] - a bill presented and passed by the Senate in March of 2013. The Provision was designed to protect growers in the event a previously approved and deregulated biotech seed becomes the subject of a lawsuit. It is likely that content generated and shared at the time that the bill was passed was negative, as it was dubbed the "The Monsanto Protection Act" by critics.

Another by-product (or driver) of (dis)information on GMOs is the establishment of new markets and marketing approaches. The Non-GMO Project mission is defined as "…a mission-driven nonprofit organization dedicated to building and protecting a non-GMO food supply. We do this through consumer education and outreach programs; marketing support provided to Non-GMO Project verified brands; and training resources and merchandising materials provided to retailers…" (Non-GMO Project, 2019). It was created in 2007 by two grocery stores, The Natural Grocery Company in Berkeley, California and The Big Carrot Natural Food Market in Toronto, Ontario, "both of which had spent the preceding years working diligently to provide their customers with more information about GMOs" (Non-GMO Project, 2019). The first product with the Non-GMO Project butterfly was introduced to the

[2] Section 735 (formerly Section 733) of US H.R. 933, a bill that was passed by the Senate on March 20, 2013 and then signed into law as part of the Consolidated and Further Continuing Appropriations Act, 2013 by President Barack Obama on March 26, 2013.

market in 2010 and, by the end of that year, annual sales of verified products reached $348.8 million. By 2011, sales rose to $1.2 billion (Gelski, 2016). By 2016, more than 2,800 brands representing almost 40,000 products bore the butterfly label with annual sales recorded at $19 billion (Gelski, 2016). As of today, more than 3,000 verified brands, representing over 50,000 products are "Non-GMO Project" verified and net more than $26 billion in annual sales (Non-GMO Project, 2019).

A real concern that such labels could provide misleading information led the Food and Drug Administration (FDA) to issue a guidance document on labeling in which they state that the "FDA's main concern within the context of this guidance is that such voluntary labeling be truthful and not misleading"(FDA, 2019). The FDA supports volunteer labeling of products with non-GMO, "….as long as such information is truthful and not misleading." A food label may be misleading, the agency continued, if "it suggests or implies that a food product or ingredient is safer, more nutritious, or otherwise has different attributes than other comparable foods because the food was not genetically engineered" (FDA, 2019).

4.0 Discussion

These data indicate that much of the most visible or impactful online coverage of genetically modified crops originates from alternative health and pro-conspiracy sites that typically frame their coverage in the most attention-grabbing fashion. Content producers, both in media and blogs, frequently cater to sensationalism when looking to increase site traffic and maximize social media engagement, which are then monetized through ad sales and site performance metrics. Individual authors at media outlets are themselves often under pressure to meet engagement quotas on their content (Petre, 2015), and may rely on tactics that, while successful in capturing attention, are not the most effective at truthfully communicating science (Marwick & Lewis, 2017).

In addition to producing some of the most shared content, alternative health and pro-conspiracy sites presented in this paper also produced content that had high median Evergreen Scores; meaning their impact on public perception and coverage of the issue persisted over time, receiving additional shares on social media or backlinks on web pages over time. Del Vicario et al. (2016) noted a similar persistence of conspiratorial content being shared over social media, while scientific reporting had a significantly shorter shelf-life.

Despite evidence to the contrary, there continues to be social and political controversy about the safety of food derived from genetically engineered crops (Snell et al., 2012). The anti-GMO movement kick-started subsequent studies and reviews, which cost the EU tax payers more than €15 million: GMO Risk Assessment and Communication of Evidence (GRACE)[3], Genetically modified plants Two Year Safety Testing (G-TwYST)[4], and GMO90+[5]. As reported in these and other journal articles, there are no harmful health effects related to consumption of GMOs (Coumoul et al., 2018; Steinberg et al., 2019). Despite

[3] Funded by the European Commission within the 7th Framework Programme. See: http://www.grace-fp7.eu/
[4] A Collaborative Project of the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration Activities. See: https://www.g-twyst.eu/
[5] Funded by the French Government. See: https://www.g-twyst.eu/

these results, nonessential use of rats in studies continues in the EU because of an obligation: for every new GMO import authorization, applicant companies are "legally obliged to conduct 90-Day feeding studies" (Späth 2018).

This case study of GMOs in the media illustrates the power that inaccurate narratives and a range of activist tools can have on businesses and societies. Poorly executed scientific studies may be picked up by the media, distorted, and amplified online and in social media (C Ryan & Vicini, 2016). There are multiplier effects where even retracted works continue to be cited (Bar-Ilan & Halevi, 2017). This further distorts the science, maligning scientific integrity, which has broader societal impacts. This preliminary study lays the groundwork for future research that could 1) involve a deeper, more qualitative dive into the text of the articles by assessing the tone of articles; 2) extend analyses and gather data through Twitter to assess how information is mobilized or driven on that social media platform (Broniatowski et al., 2018; Dredze, Broniatowski, & Hilyard, 2016).

In the network society, scientific consensus does not mean social consensus. The lack of social consensus on the benefits and safety of a given technology or product can undermine its adoption. Clearly, this has implications for businesses and science communicators alike. But policy-makers need to be vigilant of the impact that disinformation has, when the policy is based on beliefs and not supported by evidence (Gustafsson, Wolf, & Agrawal, 2017). For example, in the case of GMO disinformation, there is the cost of human lives from unnecessary delays in getting socially vital products to the market (Wesseler, Smart, Thomson, & Zilberman, 2017)[6] or shelved and unrealized innovations (Prakash, 2015; CD Ryan & McHughen, 2014), and even the loss of important research through the vandalization of field trials (Lynas, 2013).

According to Del Vicario, Bessi et al., massive digital misinformation is becoming pervasive in online social media and has been listed by the World Economic Forum as a threat to our society (del Vicario 2016). As outlined in this case study, the GMO narrative has been a longstanding and pervasive one in the media, characterized as "…an intellectual weed, a mind-polluting meme…" (Tagliabue, 2018). There are significant societal impacts of a corrupted public discourse (Colic-Peisker and Flitney 2018) as "…reporting unverified rumors as truth and willfully manipulating facts to entice more readers to click and share links is harmful to both the notion of journalistic integrity and the public good, especially in the online environment" (Chen, Conroy et al. 2015). As Lewandowsky et al (2012) suggest:

> "If a majority believes in something that is factually incorrect, the misinformation may form the basis for political and societal decisions that run counter to a society's best interest" (Lewandowsky, Ecker et al. 2012).

The socioeconomic costs of disinformation campaigns as illustrated in the case of GMOs are significant, representing a waste of money, time, and animals (Arjó et al., 2013; Barale-Thomas, 2013; Wager et al., 2013). Other less visible costs are diminished confidence in science, and the loss of important innovations and foregone innovation capacities. The most deleterious effect of long-standing anti-GMO

[6] A delay in approval of the pod-borer resistant cowpea in Nigeria is estimated to cost the country between 100 and 3,000 lives and about 33 million USD to 46 million USD.

narratives, however, may be to smallholder farmers in developing countries. Unnecessary social and political controversy about GM crops create barriers to access to technologies for those that stand to benefit from them the most.

Disinformation changes how companies do business. There is a new set of competitors that monetizes attention to support alternative campaigns that serve to disrupt and disparage social and economic innovations. This has implications for societies and businesses alike. The strategies driving the mobilization of disinformation, however, are often not visible and neither is the economy that underlies those transactions. In this paper, we take some initial steps to map the disinformation landscape through the case study of GMOs. Understanding the drivers, strategies, and the vendors that derive rents from disinformation provides ways to manage the negative effects of disinformation for both business and societies.

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Figure 1: Volume of Article Results Per Month

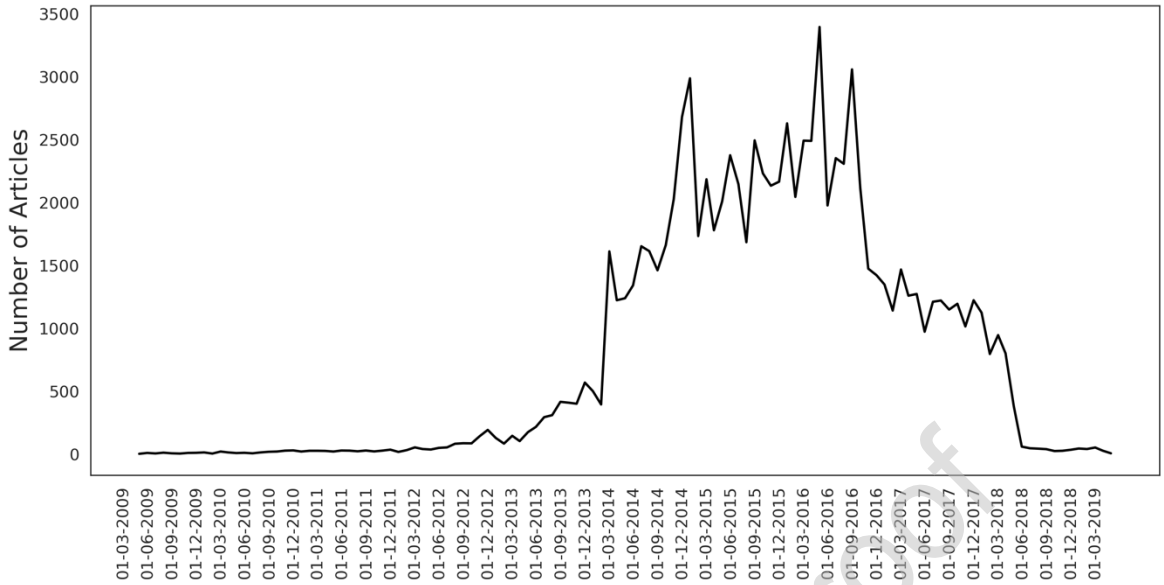

Figure legend: This graph depicts the volume of unique URLs (number of articles) per month as collected from BuzzSumo™ based on search terms (Footnote 2). Date format is Day-Month-Year.

Figure 2: Aggregated Total Shares Per Month

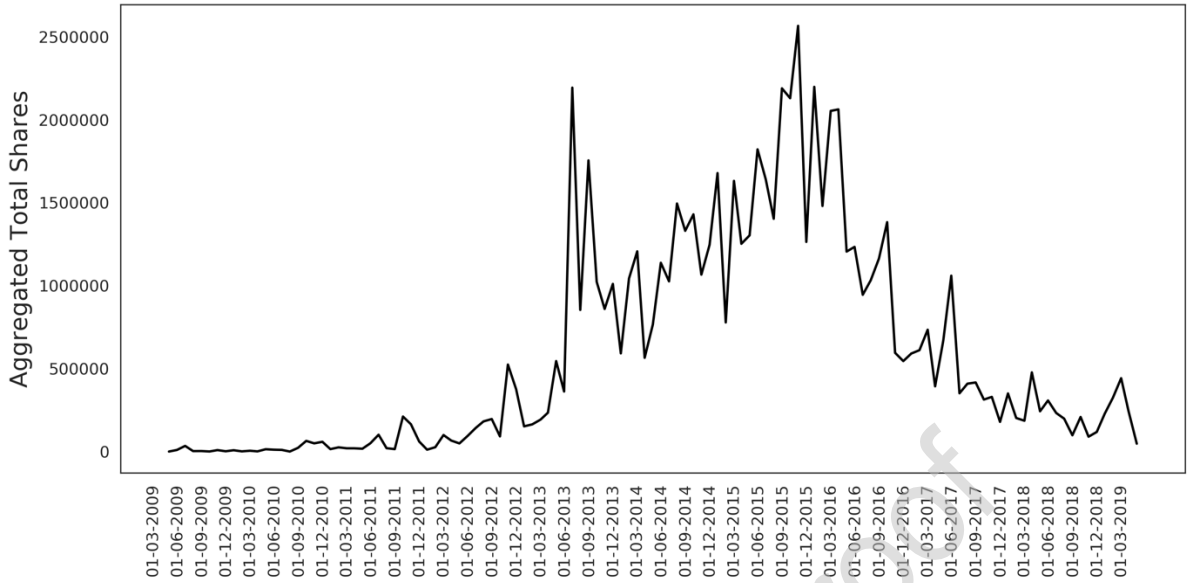

Figure legend:

This graph depicts aggregated total shares of unique URLs (number of articles) per month as collected from BuzzSumo™ based on search terms (Footnote 2).

Figure 3: Key Events and Online Engagement

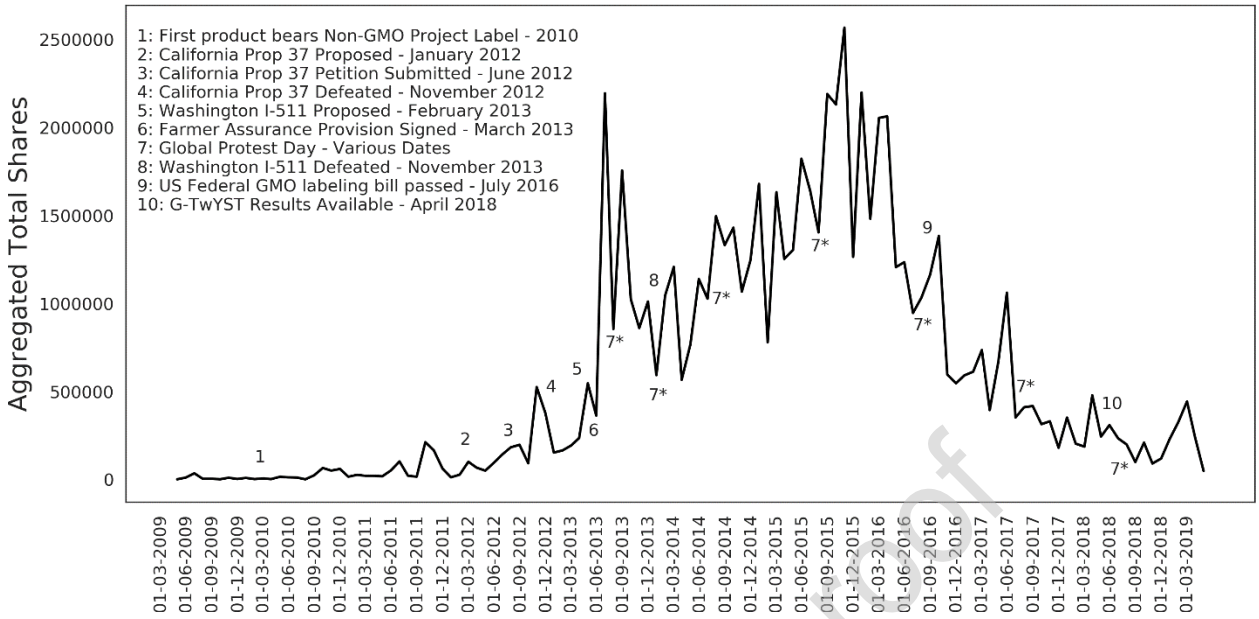

Figure legend:

This graph overlays select key events on aggregated total shares of unique URLs (number of articles) per month). It illustrates the relationships between events and engagement with online articles as collected from BuzzSumo™ based on search terms (Footnote 2).

Table 1: Median Total Shares Per Domain

Domain	Median Total Shares	Total Matching Articles
collective-evolution.com	8539	81
mercola.com	4820	148
althealthworks.com	4312	147
realfarmacy.com	4024	126
worldtruth.tv	3640	114
trueactivist.com	3103	96
takepart.com	2665	83
non-gmoreport.com	2300	206
greenmedinfo.com	2248	109
healthy-holistic-living.com	2152	107
naturalnews.com	2041	1070
enlightened-consciousness.com	1749	64
rt.com	1424	181
sustainablepulse.com	1421	186
theguardian.com	1328	53
healthnutnews.com	1291	76
motherjones.com	1273	69
ecowatch.com	1246	282
npr.org	1219	83
march-against-monsanto.com	1059	184
grist.org	1055	144
alternet.org	1049	113
the-open-mind.com	1023	60
seattleorganicrestaurants.com	971	77
yournewswire.com	952	140
minds.com	930	77
gizmodo.com	906	61
newstarget.com	905	106
agdaily.com	835	56
futurism.com	672	77
huffingtonpost.com	629	308
naturalsociety.com	604	383
cbc.ca	590	74
globalnews.ca	551	58
onegreenplanet.org	499	115

usatoday.com	482	63
theecologist.org	474	122
forbes.com	473	191
healthimpactnews.com	459	144
nationofchange.org	447	369
washingtonpost.com	441	111
cbsnews.com	430	52
iflscience.com	390	52
ewg.org	381	114
wsj.com	380	104
discovermagazine.com	380	66
activistpost.com	371	157
globalresearch.ca	342	363
skepticalraptor.com	333	50
collectivelyconscious.net	332	82

Table legend: Displays top 50 web domains ranked by median total shares. Median total shares is the median value of total shares for all articles published by a domain on the GMO topic in the dataset, which published more than 48 unique URLs in the time frame of analysis.

Table 2: Median Evergreen Score Per Domain

Domain	Median Evergreen Score	Total Matching Articles
collective-evolution.com	5.83	81
althealthworks.com	5.81	147
theguardian.com	5.75	53
npr.org	5.09	83
gizmodo.com	4.52	61
trueactivist.com	4.33	96
sustainablepulse.com	4.33	186
minds.com	4.26	77
worldtruth.tv	4.22	114
healthy-holistic-living.com	3.98	107
ecowatch.com	3.96	282
realfarmacy.com	3.94	126
seattleorganicrestaurants.com	3.85	77
takepart.com	3.75	83
rt.com	3.68	181
naturalnews.com	3.61	1070
nationofchange.org	3.56	369
grist.org	3.52	144
theecologist.org	3.49	122
greenmedinfo.com	3.47	109
yournewswire.com	3.47	140
futurism.com	3.45	77
collectivelyconscious.net	3.34	82
cbc.ca	3.34	74
globalnews.ca	3.32	58
onegreenplanet.org	3.24	115
wsj.com	3.12	104
agdaily.com	3.10	56
skepticalraptor.com	3.08	50
forbes.com	3.07	191
soundofheart.org	3.06	73
mercola.com	3.01	148
activistpost.com	3.00	157
usatoday.com	3.00	63
motherjones.com	3.00	69

wakingtimes.com	3.00	112
consciouslifenews.com	3.00	133
discovermagazine.com	3.00	66
healthnutnews.com	2.97	76
riseearth.com	2.93	61
anh-usa.org	2.88	65
huffingtonpost.com	2.87	308
washingtonpost.com	2.86	111
humansarefree.com	2.86	58
healthimpactnews.com	2.85	144
globalresearch.ca	2.79	363
civileats.com	2.67	66
cbsnews.com	2.67	52
the-open-mind.com	2.67	60
foodsafetynews.com	2.64	53

Table legend: Displays top 50 web domains ranked by median Evergreen Score. Median Evergreen Score is the median value of Evergreen Scores for all articles published by a domain on the GMO topic in the dataset, which published more than 48 unique URLs in the time frame of analysis.